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Art. II.—*Granite and Granodiorite at Powelltown, Victoria, and their Relationships.*

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Introduction.

The main purpose of this paper is to record the relationship between granodiorite and granite at Powelltown in the parish of Beenak, County of Evelyn, about 45 miles due east of Melbourne (fig. 1).

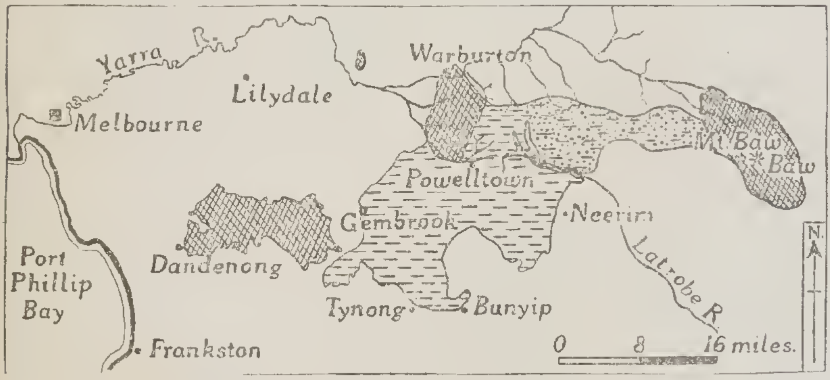

Fig. 1. Locality Map showing the Relationship of Outcrops of Granodiorite (cross hatching) to Granite (broken horizontal lines). Stippled area represents unclassified granite rocks.

The close proximity of granodiorite and granite in the Powelltown district was discovered by Mr. A. Gordon in 1936; field work which showed that the granite intruded the granodiorite was carried out by the authors in September, 1937, and the petrological relationships and the manuscript have been prepared by the senior author. The map accompanying the paper is based on contour plans prepared by the Forests Commission and by the Defence Department of Victoria.

Rock exposures in the Powelltown area are limited by conditions which have been very favorable for the accumulation of rock debris and soil. The examination of the granitic rocks was confined to a few road cuttings, a quarry, timber track clearings and one or two cleared hills on which soil erosion has occurred. Stream courses supply sparse geological exposures since sands, gravels and soils are deep, and plant growth very luxuriant, masking all critical geological boundaries. The information obtained from the area, however, is sufficient to indicate that of the two plutonic intrusions present, viz., granodiorite and granite, the granite is the younger.

The topography of the area is essentially a youthful one, characterized by fast flowing mountain torrents which drain into the mature valleys of the Latrobe River and the Little Yarra River. These are the two main streams in the area, the Latrobe flowing in an easterly direction, and the Little Yarra in a diametrically opposed direction. Whereas the tributary valleys of these two rivers are very youthful in aspect, with downward cutting far in excess of lateral widening, the mature valleys of the Latrobe and Little Yarra have built up flood plains nearly a quarter of a mile wide. The low divide which separates the Latrobe from the Little Yarra River in the eastern portion of the area, is locally known as The Bump; it is no more than 50 to 75 feet above the two rivers, and is barely a quarter of a mile wide. Minor streams in the area trend in two directions mutually at right angles, which suggests that two major systems of rectangular joints in the two intrusions are similar in strike and control the stream directions. The trend of the Little Yarra River has been mainly determined by the boundary between the granodiorite and the granite.

Nature and Distribution of the Rocks in the Area.

The rocks of the Powelltown District consist of granodiorite and granite with numerous xenoliths and three small areas of Silurian sediments. The granodiorite is a large stock occupying the north-western portion of an extensive area mapped as granitic rocks on the geological map of Victoria. The bulk of this mapped portion is a batholith of granite, extending from Powelltown in the north, to Gembrook in the south-west, Neerim in the south-east, and Tynong, Garfield, and Bunyip in the south as shown on fig. 1. The rock from Mt. Baw Baw has been described and mapped as granodiorite (2), but its extent and relationship to the granite have not been indicated.

Altered Sediments.

The small isolated areas of sediments are probably Silurian because rocks of this age occur a mile or so west of Three Bridges and outcrop as normal mudstones from here to Yarra

Junction. The main localities are (i) the head of Blackwood Gully, north of Reid's timber mill site, (ii) on the north side of the road south-east of Mt. Myrtalia, (iii) on the timber track between Powelltown and Gilderoy, and (iv) near the junction of Black Sands Creek and the Little Yarra River, about half a mile beyond the western limits of the map.

In addition to these occurrences, occasional residual boulders and pebbles occur on Big Bertha firebreak, in Seeley's Creek and just north of Lloyd's timber mill site. The outcrops in the north-central portion of the area are probably either roof pendants in the granite or rafts of included sediments; they occur some 80 yards or so from the boundary between the granite and granodiorite, and therefore do not form a continuous sheet separating the two intrusions. The outcrop between Powelltown and Gilderoy is a small remnant surrounded by hillwash. Near the junction of Black Sands Creek and the Little Yarra River, the Silurian cannot be observed in contact with the granodiorite because of soil and vegetation.

The Silurian rocks consist of hornfels, quartzite and slightly metamorphosed sandstones which occur on the surface as fragments, no definite bedding being visible. The width of the metamorphic aureole is indeterminate; it could not have been very great, since narrow remnants in the granite near the granodiorite boundary consist of slightly altered sediments as well as metamorphosed types.

Granodiorite.

The granodiorite occurs in the north-western part of the area; it is continuous from Powelltown to Warburton in a northerly direction, and the area of the outcrop is about 45 square miles. The rock is fine-grained, and as at Warburton, contains occasional quartz nodules (4, p. 174).

The best exposures occur in cuttings along the Black Sands Creek road, and in the northern part of the area where recent road construction has exposed fresh rock. Reasonably fresh outcrops occur near the granite boundary half a mile or so north of Reid's, along the timber track clearings.

Granite.

The granite covers a larger area than the granodiorite, occupying the southern, eastern and north-eastern portions of the area. Beyond the area, the geological map of Victoria shows it to be continuous with the granite at Gembrook. It has a porphyritic character and is much coarser-grained and lighter in colour than the granodiorite.

A road cutting between Powelltown and Nayook West has exposed fresh granite near Old 13 timber mill site, and a large face has been exposed in a ballast quarry at The Bump, near

Nayook West. At this quarry, portions of the granite have undergone pneumatolytic alteration, and portions have been altered to a clayey mass consisting of halloysite, a mineral of the kaolin group, which also occurs as veins following the joint planes in the granite.

Xenoliths.

Xenoliths are more common in the granodiorite than in the granite, and never exceed 12 inches across, being often as small as half an inch in diameter. They are usually fine-grained, but may occasionally be porphyritic. Some contain numerous biotite clots, and some show well marked schistose structures, especially those contained in the granodiorite in the western portions of the area. Schistose examples are infrequent in the granite.

Both melanocratic and leucocratic types are represented; by granitisation, the melanocratic examples become lighter in colour, and with mechanical disintegration, become strewn about in the host rocks, their presence being detected by indistinct spots or by clots of ferromagnesian minerals in the plutonic rocks. The leucocratic xenoliths comprise rare examples of quartzite which sometimes exhibit junctions with altered argillaceous types.

In rare examples, stringing out and partial granitisation of some of the xenolithic material has resulted in the production of imperfect schlieren-like structures in the granite, but such have not been observed in the granodiorite. Occasional pools of granitic material have been introduced into some of the inclusions, and in others, the dark coloured ferromagnesian minerals are more concentrated at junctions with the host rock.

The xenoliths invariably possess rounded outlines, produced by magmatic corrosion or by the breaking off of curved portions due to expansion on immersion in the hot magma. Contacts with the host rocks are often embayed, and at times the margins of the xenoliths are pronouncedly inshot with granitic material.

Dykes and Veins.

Veins and occasional vughs of pegmatitic quartz and felspar with tourmaline and bladed biotite, cut the granodiorite near the boundary with the granite along Seeley's Creek, on Big Bertha firebreak and north of Reid's. Partially kaolinised pegmatite also cuts the granite in the quarry at Nayook West.

Fragments of fine-grained aplite are common on the surface throughout the area, and in a few examples veins of aplite 1 inch wide and dykes up to 5 feet in width, cut through granodiorite and granite, but no examples could be traced laterally for more than a distance of 20 feet.

Quartz veins cut through Silurian quartzite north of Reid's where there is also a two inch vein of granite cutting the granodiorite. In this vein of granite, biotite is not as abundant as in the more normal portions of the main mass of the granite, and its contact with the granodiorite is relatively sharp.

Relationship of Granodiorite and Granite.

Although contacts between the granodiorite and granite at Powelltown are masked by rock debris and dense vegetation, several factors exist which indicate the relationship of the two intrusions. As far as their age is concerned, all that can be adduced from this area is that they are post-Silurian and pre-Recent. Evidence from other parts of Victoria indicates that the granodiorites and granites are generally Upper Devonian or early Carboniferous, and by analogy the Powelltown occurrences are considered to be of similar age.

Observations which serve to indicate that the granite is younger than the granodiorite are as follows:—

(i) In the hills south and east of the junction with the granodiorite, the granite is usually porphyritic, with the groundmass medium, even-grained, but in parts along the line of contact, it is not so noticeably porphyritic and is rather finer-grained, suggesting that the granite was chilled against already solidified granodiorite.

(ii) Xenoliths of sedimentary origin are numerous in the granodiorite right up to the granite contact, but in the nearby granite only one xenolith of sedimentary parentage has been observed, although sedimentary xenoliths are abundant in the granite further away from the contact. It is assumed from this that the granodiorite intruded the Silurian first, obtaining numerous xenoliths from stoped off blocks of sediment; the granite followed at a later date, and transected both the Silurian and the granodiorite, obtaining more xenoliths from the Silurian rocks than from fragments already contained in those portions of the granodiorite which became engulfed in the granite.

(iii) Near the contact on Big Bertha and north of Reid's, the granite contains included blocks of granodiorite with sedimentary xenoliths in them.

(iv) The abundance of aplite, quartz and pegmatite veins and dykes in the granodiorite near its contact with the granite, especially on hill slopes near Seeley's Creek and north of Reid's, is suggestive that the granite is the younger of the two intrusions.

(v) Near the contact north of Reid's, a vein of granite 2 inches wide cuts through a large boulder of granodiorite.

There are no metamorphic changes visible along the line of contact, but microscopic investigations show that samples of granodiorite from near the contact possess more abundant quartz, occasional pools of which are in optical continuity; orthoclase crystals are larger and more numerous; occasional micrographic intergrowths occur, and the lime felspars frequently show sericitisation. These factors indicate slight thermal metamorphism of the granodiorite, with the introduction of small amounts of granitic constituents.

Petrology.

ALTERED SEDIMENTS.

The less altered Silurian rocks consist of fine-grained micaceous sandstones in which quartz grains are set in a ferruginous or argillaceous cement containing muscovite, rounded zircon, biotite, iron ores and rare tourmaline. In examples from north of Reid's, quartz is set in an aggregate of sericite fibres and chlorite.

The quartzites are fine-grained rocks which have developed from the recrystallization of relatively pure sandstones; any impurities present have been metamorphosed to form rutile, biotite, muscovite, apatite, zoisite and iron ores in small amounts, or have remained as unaltered, rounded grains of zircon. Some of the original sediments from which the quartzites developed were not quite as pure as others, since they possess greater quantities of muscovite; pneumatolytic tourmaline has been introduced into some of the quartzites. One variety of the quartzites was apparently developed from the alteration of a calcareous sandstone for it contains abundant grains of diopside interstitial to the quartz grains. The texture of this diopside quartzite is granoblastic, sphene occurs in subordinate amount, and the only other minerals present are rounded zircon and occasional ilmenite.

In some types of hornfels, the laminations present are suggestive of preserved bedding planes, but the majority are dense and even-grained. Spotted hornfels from the firebreak on Big Bertha is composed of cordierite, biotite, muscovite, some quartz, rounded zircons and iron ores, and the spotted appearance is due to the cordierite which is often crowded with numerous small plates of biotite. Cordierite-biotite hornfels from near the junction of Black Sands Creek and the Little Yarra River, is comparable with types described from the Bulla contact zone (7), containing cordierite, biotite, iron ores, rounded zircons, apatite, muscovite and tourmaline. Quartz-biotite-cordierite hornfels from the right bank of Seeley's Creek, but not in situ, is coarser-grained than the cordierite-biotite hornfels and has a more vitreous lustre; some of the cordierite crystals in it have been corroded by the quartz.

In all these metamorphosed sediments, even when they occur as xenoliths, the original rounded detrital grains of zircon persist unchanged by metamorphism.

The Granodiorite.

The granodiorite is a fine and even-grained rock composed of quartz, orthoclase which is sometimes microperthitic and poikilitic, oligoclase-andesine, abundant biotite with numerous inclusions and pleochroic haloes, chlorite with sphene and ilmenite along the cleavage planes, apatite and zircon, and occasional small veins of tourmaline which sometimes replace biotite. Symplektitic intergrowths occasionally develop at orthoclase-plagioclase contacts. Portions of the granodiorite near the granite boundary show slight changes due to metamorphism. The introduction of numerous small patches of quartz has developed a sieve structure in the biotite in parts of the rock.

Micrometric analyses of the granodiorite at Powelltown and Warburton (4, p. 173) show the main minerals to be present in the following proportions:—

Table 1.

—	I.	II.
Quartz	31·2	28·1
Orthoclase	16·3	12·4
Plagioclase	31·6	34·5
Biotite	18·6	24·0
Accessories	2·3	1·0

I.—Granodiorite, Powelltown.
II.—Granodiorite, Warburton.

The Powelltown analysis, representing the southern, and the Warburton analysis representing the northern portion of the intrusion are closely similar. Table 1 shows that quartz, orthoclase and accessory minerals are slightly greater, whilst plagioclase and biotite are smaller in amount at Powelltown. This is perhaps due to the proximity of granite and the assimilation of sedimentary material at Powelltown, whilst at Warburton, the granodiorite has no known neighbouring intrusion of granite from which additional quartz and orthoclase could have been introduced, and has assimilated dacite as well as sediments.

The following table (Table 2) indicates that the heavy mineral assemblage and index number of the granodiorites at the widely separated localities of Powelltown (I.) and Warburton (II.) are again similar:—

TABLE 2.

—	I.	II.
Apatite (colourless)	C	C
,, with pleochroic cores	V	..
,, (corroded)	V	..
Biotite	A	A
Chlorite	o	A
Garnet	V	V
Hornblende	..	r
Hypersthene	..	o
Ilmenite	V	o
Pyrite	o	r
Sphene	V	..
Tourmaline	V	..
Zircon (colourless)	o	o
,, (pale yellow)	V	V
,, (inclusions in)	o	r
,, (zoned)	V	V
,, (corroded)	V	V
,, (water clear)	V	V
,, ("torpedo")	V	V
,, (pyramidal)	V	V
Zoisite	V	o
Specific Gravity	2·72	2·72
Index Number	16·9	19·9

A = very abundant; C = common; o = occasional; r = rare; V = very rare.

At Powelltown, the tourmaline has been introduced from the later granite intrusion, whilst the hornblende at Warburton has been produced from the assimilation of dacite, and the hypersthene is probably a residual product of the dacite. The higher index number in the Warburton area is attributed to the presence of slightly more chlorite, biotite and ilmenite, generated from the breaking down of the hypersthene in dacite xenoliths.

THE GRANITE.

The granite is a light coloured, medium-grained to porphyritic potash granite containing orthoclase, quartz, acid oligoclase, biotite, secondary muscovite and accessory minerals. Orthoclase is often microperthitic; biotite does not contain nearly as many inclusions and haloes as do crystals of biotite in the granodiorite, and it sometimes shows dactylitic intergrowth with quartz. Chloritisation of the biotite is not uncommon, and the chlorite contains epidote as well as the other by-products of the alteration, sphene and ilmenite. Symplektitic pustules occur at some of the orthoclase-plagioclase contacts, and such intergrowths are more common in the granite than in the granodiorite of this area.

Veins of orthoclase which are interstitial between quartz crystals, show that the crystallization of the orthoclase overlapped that of the quartz; a similar occurrence in the granodiorite suggests that this late-crystallization orthoclase may have been derived from partial soaking in of granite magma near the end stages of solidification. In some instances, quartz has embayed biotite plates, and in the bays, numerous small apatite and occasional zircon crystals included in the quartz, were formerly inclusions in the biotite. Occasional clusters of biotite plates associated with numerous apatite crystals are remnants of xenolithic strew, whilst poikilitic quartz and orthoclase also indicate digestion of xenolithic material.

In the quarry at Nayook West, portions of the granite have suffered pneumatolysis with the introduction of pyrrhotite, tourmaline and fluorite. This part of the granite is much poorer in biotite than the granite exposed elsewhere in the area, and contains microcline microperthite which is the last mineral to crystallize from the granite intrusion, since it often poikilitically encloses crystals of quartz, and also occurs in some of the veins cutting the granite.

The micrometric analysis in Table 3 is representative of the granite in the Powelltown district, being obtained from thin sections of samples from six localities; that of the You Yangs (1, p. 128) is added for comparison:—

TABLE 3.

—	I.	II.
Quartz	32·0	28·7
Orthoclase	34·7	34·8
Plagioclase	25·6	25·5
Biotite	5·7	8·8
Accessories	2·0	2·2

I.—Granite, Powelltown.
II.—Granite, You Yangs.

Although the mineral percentages are very similar for the two examples, variations occur in that the You Yangs granite is a soda-rich type and contains minerals like microcline, orthite and hornblende not recorded from the more normal portions of the potash granite from Powelltown. The amounts of orthoclase, plagioclase and accessory minerals in each type, however, are remarkably similar.

Table 4 illustrates the variation in the heavy minerals of the granite, sampled portions treated for heavy mineral analysis being obtained from Nayook West, Gembrook, Bunyip, Powelltown, Mount Beenak, Garfield and Tynong. Separation into light and heavy fractions was effected in bromoform of specific gravity 2.88. The index number is lowest for pneumatolysed portions from the quarry at Nayook West, and highest at Mount Beenak where slightly more biotite has been produced from rather greater assimilation of xenoliths. The average index number for the three Powelltown localities (i.e., Powelltown, Nayook West and Mount Beenak) is 4.4 and the average specific gravity is 2.64, these figures being comparable with those obtained from the granite outcropping at Gembrook and Bunyip.

The heavy mineral indices and assemblages obtained from localities outside the Powelltown area are added for comparison, and it is seen that at Garfield and Tynong the granite has higher index numbers because local assimilation of included rock fragments has been greater, and basic clots and schlieren are more abundant. The variation in the index numbers is due to the generation of varying amounts of the ferromagnesian minerals consequent upon xenolithic digestion, but the primary accessory minerals, like zircon and apatite, remain fairly constant in amount and character throughout this granite massif.

TABLE 4.

	I.	II.	III.	IV.	V.	VI.	VII.
Index Number	1·8	4·7	4·8	4·8	6·5	10·1	10·3
Specific Gravity ..	2·61	2·63	2·64	2·64	2·66	2·66	2·64
Actinolite	..	..	..	..	V	..	..
Apatite (colourless) ..	o	C	o	C	o	C	C
„ with pleochroic cores	..	..	V	V	V	..	r
Biotite	C	A	a	A	A	A	A
Chlorite	a	C	C	o	o	o	o
Epidote	..	V	..	V	..	V	..
Fluorite	V	..	..	V	..	..	V
Garnet	..	V	..	V	V	..	V
Hornblende	..	V	a	..	..	a	C
Ilmenite	o	r	r	C	C	o	V
Orthite	..	..	..	..	..	..	V
Pyrite	a	V	..	V	V	..	o
Rutile	..	..	..	..	..	V	..
Sphene	o	r	o	..	..	o	o
Topaz	..	V	..	..	..	V	V
Tourmaline	V	V	r	V	..	..	..
White Mica	r	V	V	V	V	V	V
Zircon (colourless) ..	o	C	o	o	C	C	C
„ (pale yellow) ..	V	r	..	o	r	V	V
„ (inclusions in) ..	o	o	C	o	o	a	a
„ (zoned)	r	r	o	V	r	o	o
„ (corroded) ..	V	V	..	V	V	r	..
„ (water clear) ..	V	V	V	V	V	V	V
„ (parallel growths)	..	..	..	..	V	V	..
„ (acicular) ..	V	V	..	V	V	V	V
„ (asymmetrical) ..	..	V	V	V	V	V	V
Zoisite	..	V	..	..	..	V	..

A = very abundant; a = abundant; C = common; o = occasional; r = rare; V = very rare.

I.—Nayook West.
II.—Gembrook.
III.—Bunyip.
IV.—Powelltown.
V.—Mt. Beenak.
VI.—Garfield.
VII.—Tynong.

XENOLITHS.

The xenoliths in the granodiorite are all sedimentary xenoliths, and present various stages in the contact metamorphism of the Silurian rocks. In schistose and foliated examples, the banding arises from the parallelism of alternating laminae of biotite and quartz; this may be due to the original heterogeneity in the sediment as suggested for banded hornfelses (8, p. 64), or to stretching and flow banding resultant upon the movement of the hot plastic xenolith in the magma.

Microscopical examination shows that the xenoliths in the granodiorite may be either siliceous, aluminous, or characterized by actinolite, by biotite and plagioclase, or by biotite and orthoclase.

The siliceous xenoliths consist essentially of granular quartz and diopside; grains of sphene are common, actinolite surrounds some of the diopside crystals and may indicate the initial conversion of pyroxene to amphibole, a reaction produced during the cooling of the rock, and representing re-adjustment to conditions of lower temperature (8, p. 35); apatite, rutile, muscovite, rounded zircons, pyrite, pyrrhotite, orthoclase and plagioclase also occur. The rocks in this group represent schistose diopside quartzites which have been subjected to more severe metamorphism than they experienced as contact rocks, so that coarser-grained textures and alignment of the constituents have been produced.

The aluminous xenoliths are schistose and foliated inclusions with variable amounts of spinel, corundum and sillimanite. They represent an early stage in the alteration of aluminous sediments. The spinel occurs in clusters and strings of idioblastic crystals (5, p. 38) similar to those occurring in silica-poor hornfelses (8, p. 44); it is the deep green pleonaste variety, and its presence marks the rock as one deficient in silica. Although free quartz is present in the same rock section as spinel and corundum, these two minerals are never in direct contact with the quartz, some of which has been introduced from the granodiorite magma. This occurrence of spinel and quartz together in xenoliths, indicates a lack of equilibrium and a limited condition of diffusion which is rapidly passed when mechanical disintegration of the xenoliths begins (3, p. 366), and with increased granitisation of these xenoliths, spinel and corundum are eventually changed to felspar. Read suggests that spinel-corundum xenoliths belong to the silica-poor members of the argillaceous-calcareous hornfelses, and that the surplus alumina of the sediments gave rise to the production of spinel (6, p. 449). Spinel-corundum xenoliths in the Powelltown district are considered to have arisen in like manner, being of sedimentary origin.

The corundum occurs as irregular crystals both patchy blue to colourless and deep blue (sapphire) in colour. It has been produced in the absence of free quartz from rocks relatively rich in sericite, and frequently occurs as idioblasts embedded in a granular matrix of orthoclase. The corundum has been partially altered to a micaceous product containing irregular relics of the fresh mineral as also observed elsewhere (6, p. 447), and both the corundum and the spinel occur as armoured relics, the protective barriers around them being biotite, muscovite, sillimanite and orthoclase.

Iron ores, limonite, rounded zircons, rare oligoclase, zoisite and sphene are also present in the aluminous xenoliths. Orthoclase is poikilitic in examples which have been subjected to more advanced grades of metamorphism, and it includes abundant apatite rods. In some examples, pneumatolytic tourmaline and pyrite, and rare crystals of zircon have been introduced from the granodiorite.

The xenoliths characterized by the presence of actinolite consist of plagioclase, actinolite containing rare residual grains of augite, biotite, abundant apatite, lobate growths of quartz in optical continuity, ilmenite, rounded zircons, rare rutile and zoisite. They were formed from sediments containing small amounts of lime originally.

The biotite-rich xenoliths consist of two types, one in which plagioclase felspar is dominant, and another with orthoclase as the dominant felspar; in each of these types, quartz and biotite are about equally developed. They were produced from sediments which initially contained equivalent amounts of silica and alumina, but varying amounts of potash. The biotite-rich plagioclase xenoliths form the most abundant inclusions in the granodiorite; they are dark and fine-grained, having biotite arranged in decussate structures. The granodiorite adjacent to these xenoliths contains xenocrysts of rounded zircon and rutile, whilst orthoclase and plagioclase are often poikilitic and the plagioclase crystals are sometimes zoned with remnants of xenolithic material. Some of the biotite in the granodiorite close to the xenoliths, and much of it in the xenoliths, is sieved by quartz, and occasional ocellar structures have been formed where the biotite was forced aside by growing crystals of quartz.

The biotite-rich orthoclase xenoliths were originally sediments poor in chlorite, but they apparently possessed abundant sericitic material; with advancing metamorphism, muscovite and subsequently orthoclase were produced from the sericite.

Xenoliths in the granite at Powelltown are of sedimentary and igneous origin. Amongst the sedimentary xenoliths, only two types have been recognized, the biotite-rich plagioclase xenoliths and the biotite-rich orthoclase varieties which are like those in the granodiorite except that most of them are more granitised. The xenoliths of igneous origin in the granite are reconstituted granodiorite; they contain large zircons with well-defined crystal faces and the grain size varies from fine to medium. Large plates of biotite contain haloes and inclusions as numerous as those in the main mass of the granodiorite, and they have a definitely igneous aspect in contrast to biotite crystals developed from the alteration of the sedimentary rocks, where they always occur as small laths, often in decussate arrangements, or as elongated shreds.

Summary and Conclusions.

Two plutonic intrusions invaded Silurian sediments in the Powelltown district, one of them being granodiorite intruded as a stock, and the other a granite of batholithic nature. The limited field evidence indicates that the granite is the younger of these two intrusions.

Accidental xenoliths from both of these igneous masses have been grouped according to the main variations in composition as reflected by the mineralogical associations. Different textures have been produced in the xenoliths corresponding to the different degrees of thermal metamorphism to which they have been subjected. The fact that xenoliths in the granite are more granitised and drawn out into schlieren than corresponding types in the granodiorite, which often still retain traces of sedimentary structures, lends support to the conclusion that the granite is the younger of the two intrusions.

There has been no sedimentation or igneous activity between the late Devonian or early Carboniferous intrusive period and the deposition of Recent hillwash and alluvium. Agents of erosion must have been actively at work throughout this time to have removed practically all of the Silurian cover and expose and dissect the underlying granitic rocks.

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N.
M.M.
Ada River
Mt. Myrtalia
Myrtle Ck.
Sands Creek
Black
Little Yarra River
Three Bridges
Gilderoy
Lloyd's
Hocketts Ck.
Mt. Beenak
Seeley's Ck.
Big Bertha
Reid's
Tin Mine Ck.
Blackwood Gully
Mackley's Ck.
Powelltown
Fitzpatrick's
Tunnel
The Bump
Quarry
Nayook West
Old 13
Latrobe River
Tracks and Firebreaks
Millsites
Timber Tramlines
SCALE
Alluvium
Hillwash
Aplite
Granite
Granodiorite
Silurian